is the frequent shocks to which the family in general were subjected, and the collecting of electricity in their large Leyden jars. But their work was really serious, and was continually expanding. They went on to make voltaic piles and galvanic batteries, experimenting with metals and fluids, and on light and heat, and magnetic electricity. Soon William's attention was turned to the polarisation of light, and he pursued experiments in this field of inquiry with extraordinary eagerness and delight. The brothers contrived and themselves made most if not all of the apparatus they used in their experiments."

"Their happy winter workdays were pleasantly varied with summer rambles. Dr. Nichol, the famous professor of astronomy, had taught these classes in natural philosophy during the illness of the professor, and in summer he took James and William a two or three days' ramble over the volcanic region of the Siebengebirge, climbing the Drachenfels on their last morning."

All science was their province. Lord Kelvin always claimed that natural philosophy comprehended all the sciences.

"Before setting out on our travels in 1840," his sister writes that "William had got Fourier's 'Théorie analytique de la Chaleur' from the college library, and when studying the book one day he suddenly sprang from the stool on which he was sitting and excitedly exclaimed, 'Papa, Fourier is right and Kelland is wrong.' Our father was rather incredulous, but on examination he found that in the points in which Kelland had declared Fourier mistaken it was Kelland himself who was mistaken and not Fourier. He made the boy write an article for the Cambridge Mathematical Journal, and sent it to Gregory, the editor. It was shown to Kelland before it was published. At first he was very much annoyed, but after some expressions had been altered he was satisfied to let it appear. I may add that Kelland became very friendly with William, and as long as he lived the friendship continued."

In 1841 William went to Cambridge, and the story of his life there is well known.

"A brilliant university career was before him. He was also distinguishing himself as an oarsman. A nice second-hand 'funny' came in his way, which he did not lose the opportunity of securing. It was 27 ft. long, painted blue, and bordered with a band of gilding. It was decked or covered all over except a hole in the middle, where the rower sat, and it was so light that William could carry it himself if need were. He called it the 'Nautilus.' He became as enthusiastic in boating as he was in everything he set about, and he won many prizes in the races. Like a jockey, he used to regulate his food so as to form good strong muscle without increasing his weight. . . . When he won the Silver Sculls, it was better, he declared, than winning an examination."

The story of his second wranglership and subsequent first Smith's prizemanship has often been told. When the first list came out he writes to his sister that the principal thing he cared about in the result was the disappointment he was afraid papa must feel, "as I am afraid he had rather raised his hopes about it, though I tried to keep him from expecting too much before the examination, as I knew the uncertainty."

Next year came welcome compensation. At the age of twenty-two William was elected professor of natural philosophy in Glasgow, to the chair which he made so famous during the half-century of his occupation. It was delightful, for his father, now his colleague, was becoming frail. He died of cholera in Glasgow two years and a half later. But he had seen in his declining years the splendid outcome of his long life-work. James Thomson's numerous text-books were excellent in their day. They had an enormous circulation, and were of the utmost service in the education of the time. But his greatest work was his teaching of his own family. While his most enduring monument is the splendid fame of Lord Kelvin and his elder brother, James Thomson, he did work not less memorable in shaping and developing the beautiful lives of all the six children, to whom he was father and mother in one. It was in that warm and loving home that Lord Kelvin and his brothers and sisters found the intellectual and moral nourishment that made them what they came to be in their day and generation.

W. J.

PROTOPLASM IN HARNESS.

Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditerranée. By Dr. C. Houard. Two vols. (I. 1908, II. 1909). Pp. xvi+1248. (Paris: A. Hermann et Fils.) Price, two vols., 45 francs.

GALLS on plants, in at least the more conspicuous forms, must have been known to man from a very early period in his history, and the presence in them of living animals might have been expected to suggest inquiries as to their source and relation to plants, yet even after Malpighi had published the results of his study of various galls, and had been followed by Reaumur in his admirable "Mémoires," the interest in those curious growths long remained limited to a very few. To botanists they were little more than excrescences on, or defects of, plants, lessening their value as specimens, while zoologists were rarely attracted to the study of the makers, which belonged for the most part to mites, nematode worms, midges, and other groups difficult to study, and little attractive in themselves.

But the latter half of the nineteenth century was marked by an almost sudden outburst of activity, about 1870, led by Drs. F. Thomas, D. von Schlechtendal, F. Löw, G. Mayr, and others, resulting in numerous papers filled with descriptions of previously unknown galls, and gall-makers, and with life-histories disclosing new relations between plants and animals, as well as new cycles of development of the animals. Such discoveries as the surprising dimorphism so general among the Cynipidæ that gall the oaks attracted keen interest, which showed itself in an increase of workers, and in a more and more rapid advance in the study of galls, especially in faunistic researches, and in more accurate determinations of the gall-makers and of the influence on one another of host and parasite.

The diversities in structure among galls (the alterations induced by the gall-producers in some cases amounting only to slight enlargement of the parts involved, while in others they result in bodies of complex nature and definite specific forms), and the systematic relations among the numerous gall-bearing plants, and also among the gall-producers, support the

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belief that the power to affect the protoplasm so as to lead it to produce structures useful to the gall-makers has been acquired independently by numerous organisms (plants as well as animals), in widely different grades of development. If that is so, it seems reasonable to expect that power to control the activity of protoplasm will, at least to some extent, be acquired by man, and may produce results of great value. Although as yet experiments have thrown little light on the artificial production of galls, there is a very attractive field open for research in this direction.

Since 1870 an extensive literature has appeared dealing with galls, dispersed so widely that much of it was almost beyond reach of even keen students in this field. In 1858 G. von Haimhoffen estimated the known galls of Europe at from 300 to 350. In Kaltenbach's "Planzenfeinde," issued in 1873 and 1874, the galls of Central Europe formed by insects, and by a few mites, were described under the host-plants; and from 1890 to 1895 D. von Schlechtendal issued a catalogue of the galls of animal-origin then known to occur in Germany.

In 1901 appeared two works giving brief descriptions of the galls of Europe and of the Mediterranean area, Kieffer's "Synopsis des Zoocécidies d'Europe," and Darboux and Houard's "Catalogue systématique des Zoocécidies de l'Europe et du Bassin Méditerranéen." These were most welcome, and stimulated research so greatly that a new catalogue had already become necessary when M. Houard supplied the need by his latest work, "Les Zoocécidies des Plantes d'Europe et du Bassin de la Méditerranée." Based upon the "Catalogue," and covering the same area, comparison of the two shows remarkable progress during the few years that elapsed between their dates of issue. Such a comparison is a little hindered by the host-plants being arranged in the earlier list in alphabetical order of the generic and specific names, while in the later they are in families, these following the order in Engler's "Pflanzenfamilien," while within each family the genera and species are grouped after Nyman's "Conspectus Floræ Europeæ." The advantages derived from the re-arrangement of the host plants beside their allies far outweigh those of the alphabetical arrangement.

The comparison between the individual hosts in the two lists shows very careful revision of the descriptions common to both, the omission from the second of some forms included in the first, the definite reference to their makers of numerous galls previously of unknown or doubtful origin, and the addition of many recently discovered galls, some on plants already known to bear galls, others on new hosts. A rough indication of the advance is given in the rise of the marginal numbers attached to the galls from 4169 to 6239; but perhaps a truer value is afforded by the increase of the host-plants in much the same proportion, and of the known gall-makers from 1072 to 1366 species, the increase being especially large among the Curculionidæ (beetles), the Cynipidæ (gall-flies), the Cecidomyidæ (gall-midges), and Eriophyidæ (gall-mites). Numerous additions have been made to the very useful illustrations scattered through the book.

An important addition is a bibliography of the literature on galls, which, though not complete, is the best that has yet been published, and will be found most helpful as a guide, while its value is increased by references to it under each gall; and the countries in which the galls have been found are also indicated very briefly, yet simply. Under each host-plant the galls are arranged on the same method as was employed in the "Catalogue systématique," viz., terminal galls of fruits, flowers, stems, and buds, followed by lateral growths on roots, stems, branches, leaves, &c. In most cases this method makes it possible to ascertain the name of any gall without serious difficulty; but on some of the oaks and a few other plants the forms are so numerous as to lead to further subdivision of the groups by subordinate characters.

The arrangement of the plants in families has allowed a brief but suggestive outline of the leading features of the galls characteristic of each family, and of occasional suggestions for inquiries.

Careful indexes of the host-plants and of the gall-makers add greatly to the usefulness of the book, and the typography is excellent. It is, in a very literal sense, indispensable to all students of galls, while those interested in the problems as to the nature of living matter and its responses to stimuli will find in its pages much matter for further investigations.

ELECTRICITY ON THE FARM.

Électricité agricole. By A. Petit. Pp. 424. (Paris: J. B. Baillière et Fils, 1909.) Price 5 francs.

THIS book is one of the sixty volumes of the "Encyclopédie agricole," published under the editorship of M. Wery, the scope of which is well summed up in the introduction :—

> "Extraire de notre enseignement supérieur la partie immédiatement utilisable par l'exploitant du domaine rurale et faire connaître du même coup à celui-ci les données scientifiques définitivement acquises sur lesquelles la pratique actuelle est basée."

It is in no sense a popular exposition of the principles of electricity, but is rather written for the intelligent farmer who knows something about electricity and also about engineering, and is enterprising enough to investigate the merits of a new suggestion.

The first chapter is devoted to a recapitulation of the general principles and the system of units employed. No attempt is made to dispense with technical expressions; "connaître le vocabulaire d'un art, c'est déjà connaître cet art." The modes of transforming mechanical into electrical energy are then discussed in a very interesting chapter, the sources of energy dealt with being water power, steam, oil, and wind. Of all these wind would be by far the best if electricity had to be generated on the farm itself, but the difficulties are considerable. Attempts have been made in this direction particularly by M. La Cour in Denmark, whose trials are perhaps the most complete yet made, and who has demonstrated the possibility of utilising wind if there is also some subsidiary source of power. But the subject is by no means exhausted, and the utilisation of the energy of

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